MECHATRONIC DESIGN AND CONTROL OF A WASTE PAPER SORTING SYSTEM FOR EFFICIENT RECYCLING
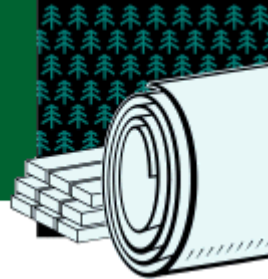
BENEFITS

- Replaces manual sorting of waste paper
- Improves quality and homogeneity of recycled fibers
- Recycles a greater percentage of mixed waste paper than present rates
- Characterizes waste paper automatically
- Provides a quality check for buyers and sellers of waste paper
- Saves 32 trillion Btus of energy annually
- Decreases production of 66 million tons of solid waste
- Conserves 22 billion gallons of waste water

APPLICATIONS

The automated sorting technology is applicable to 100 percent of the paper recycling market. It is expected to achieve a market share of 75 percent of the paper and board mills and recycling plants in this country. The commercial system should be in place by 2004, and take 10 years to saturate the market.

Automatically Sorted Waste Paper Improves Efficiency of Paper Recycling Facilities

Ninety-five million tons of paper are consumed each year in this country, but only 43 million tons are recovered to produce new paper. The closure of landfills and lack of waste-disposal facilities make it difficult to handle the remainder of the waste paper without increased recycling activities. Since well-sorted waste paper is a better feedstock for paper recycling facilities than mixed paper, an automatic sorting technology is sought to replace the current method of manually sorting recovered paper or sending recovered paper to recycling mills unsorted.

Researchers at North Carolina State University believe that in the near future, nearly all of the approximately 700 paper and board mills and recycling plants will use some recycled fiber in their processes. To improve the economics of recycling paper, they are developing a completely automated system to sort waste paper at commercially effective speeds.

If successful, an automatic, computerized method of characterizing waste paper will improve the quality of recycled fibers sent for further processing. It will also decrease energy costs and the cost of waste and water disposal for paper-recycling plants.

PROJECT DESCRIPTION

Goal: To develop and understand an efficient, fast, accurate, and completely automated waste paper sorting system.

Researchers will apply the principles of mechatronic design to this problem (i.e., the fusion of mechanical engineering with electronic and intelligent computer control in the design and manufacturing of industrial products and processes). There will be two phases to the research: (1) handling/moving the waste paper through a sorting system, and (2) detecting characteristics of the paper and identifying the type of waste paper.

They will develop components to mechanically screen the waste paper, prepare the paper for image analysis, carry the paper past optical sensors, and separate the paper into different bins. Sorting will be conducted based on optical properties, including color identification using a multiple-object color tracking system to identify sample categories based on color. The Cognachrome Vision System should provide real-time capabilities that previous research in this area has not realized.

PROGRESS & MILESTONES

The following milestones have been identified for reaching the objectives of this research:

- After a discussion with the project mentor in June 2000, researchers decided it would be useful to look at the full spectrum response of materials in wastepaper instead of just using an LED type color sensor, possibly leading to a new targeted sensor.
- A literature survey studied optical properties of paper and lignin and previous attempts at automating this process.
- Researchers visited two sorting plants to evaluate the existing sensors that could be useful for this project.
- The study indicated that various grades of paper differ in their lignin content.
- Investigation concluded that the initial objective of sensing can be achieved using a high speed vision system to identify colored papers and using an optical analyzer with CCD camera to identify different grades of paper based on their lignin contents. It is also proposed to interface the two using sensor fusion.
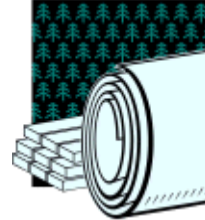
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